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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0300 Roll No.

B.Tech

(SEM VII) ODD SEMESTER THEORY EXAMINATION 2009-10

FUNDAMENTAL OF DIGITAL SIGNAL PROCESSING

Time : 3 Hours] *[Total Marks : 100*

Note : *(i) Attempt **all** questions.*

*(ii) All questions carry **equal** marks.*

1 Attempt any **four** parts of the following questions : 5×4

(a) Compute the signal energy for $x(t) = e^{-4t}U(t)$.

(b) Explain the stability condition for the DSP systems described by the equation $y(n) = a^n U(n)$.

(c) Determine the Fourier transform for a rectangular pulse having pulse width T seconds and magnitude of A volts.

(d) Compute DFT of the sequence $x[n] = \{0, 1, 2, 3\}$. Define twiddle factor and its properties also.

(e) Compute the circular convolution of the following sequence and compare the results with linear convolution. $x_1[n]=\{1, 2, 0, 1\}$ and $x_2[n]=\{2, 2, 1, 1\}$.

(f) State and prove following properties of DFT (i) circular time shifting (ii) circular time reversal.

2 Attempt any **four** parts of the following questions : **5×4**

(a) Draw the spectrum of a sampled signal and explain aliasing.

(b) Discuss the process of reconstruction of the signal from its samples. Obtain the impulse response of an ideal reconstruction filter.

(c) Explain the need for multirate signal processing.

(d) Given $x(n)=\{0, 1, 2, 3\}$, find $X(k)$ using DIT FFT algorithm.

(e) Find the impulse response and frequency response of the second order system defined by equation

$$y[n]-y[n-1]+3[n-2]/16=x[n]-0.5x[n-1]$$

(f) Find the magnitude and phase response for the system characterized by the difference equation :

$$Y[n]=x[n]/6+x[n-1]/3+x[n-2]/6$$

3 Attempt any **two** parts of the following questions : **10×2**

(a) Obtain FIR linear phase and cascade realization of the system function

$$H[Z]=\left[\left(1+0.5Z^{-1}+Z^{-2}\right)\left(1+0.25Z^{-1}+Z^{-2}\right)\right]$$

(b) Compare Direct form I and Direct form II realization of IIR filter system.

(c) Determine the variance of the round off noise at the output of the two cascade realization of the filter with system function

$H[Z]=H_1[Z]\cdot H_2[Z]$ where

$H_1[Z]=1/\left(1-0.5Z^{-1}\right)$ and

$H_2[Z]=1/\left(1-0.25Z^{-1}\right)$

4 Attempt any **two** parts of the following questions : **10×2**

(a) Write short notes on (1) Gibbs Phenomenon (2) Optimum equiripple FIR filter design.

(b) A low pass filter is to be designed with the following desired frequency response

$$H_d\left(e^{j\omega}\right)=e^{-j2\omega} \quad \text{for} \quad -\pi/4\le\omega\le\pi/4$$
$$=0 \quad \text{for} \quad \pi/4\le\omega\le\pi$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$w(n) = 1 \quad \text{for} \quad 0 \le n \le 4$$
$$= 0, \text{ for otherwise}$$

Also determine the frequency response $H\left(e^{j\omega}\right)$ of the designed filter.

(c) Discuss the different design techniques available for IIR filters.

5 Attempt any **two** parts of the following questions : 10×2

(a) Write short notes on (1) Goertzel Algorithm (2) Effect of finite world length in digital filters.

(b) Explain how DFT and FFT are useful in power spectral estimation. Define periodogram.

(c) Draw the flow graph of an 8 point DIF FFT algorithm and explain.
